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Tracor Document Number T-77-RV-109-C
Tracor Contract Number N00014-76-C-0066

FINAL REPORT
FOR
CONTRACT N00014-76-C-0066 (U)

Submitted to:

Naval Ocean Research & Development Activity
NSTL Station, Mississippi 39520
Attention: Code 600

November 30, 1977

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Unauthorized Disclosure Subject
to Criminal Sanctions

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Tracor Contract Number N00014-76-C-0066

6 FINAL REPORT
FOR
CONTRACT N00014-76-C-0066 (U) 8

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1.0 (U) INTRODUCTION (U)

(U) During the period July 1, 1975 to September 30, 1977, Tracor, Inc. was asked by the LRAPP Manager to perform the following work on the Long Range Acoustic Propagation Project (LRAPP)-Contract N00014-76-C-0066:

1.1 Attachment Number I, 1 July 1975 (U)

(U) Task 1 - Assist in the analysis of data from the Mediterranean Anti-Submarine Warfare (ASW) Augmentation Program to determine the interactions between the ASW environment and ASW systems.

(8) Task 2 - Assist in the planning, analyses, and tests leading to the incorporation of a higher frequency capability into the TASSRAP on board prediction system.

(8) Task 3 - Assist in the development of plans for the SUDS II tests.

(U) Task 4 - Provide technical support to the LRAPP in the areas of technical report review, special analyses and meetings on a quick reaction basis.

(8) Task 5 - Participate as a member of the LRAPP Measurement Systems Advisory Group (MSAG).

(U) Task 6 - Review, rewrite as necessary, and publish an area assessment of the CHURCH ANCHOR Region for MSS. 1

(U) Task 7 - Assist in the conduct of a preassessment study of the Indian Ocean addressing the environmental/acoustic effects on selected sensors. Involved will be an analysis of the environmental/acoustic environment and a report recommending specific acoustic experiments in support of these sensors.

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(U) Task 8 - Provide an analyst to assist in the conduct and analysis of a LRAPP supported Third Fleet Exercise. Assess the utility of the TASSRAP Program in supporting Fleet operating units and incorporate lessons learned into the development of TASSRAP.

1.2 Attachment Number II, 25 January 1976 (U)

(U) Task 1 - Conduct a review of the existing TASSRAP program and incorporate lessons learned during the recent COMTHIRDFLT Exercise to arrive at a set of specifications and a program plan for TASSRAP O/B.

(U) Task 2 - Assist COMTHIRDFLT in completion of the analysis and reporting of exercise KENT BEACON.

1.3 Attachment Number III, 15 May 1976 (U)

(U) Task 1 - Provide recommendations to prioritize, both in scope and time sequencing, additional analysis effort from past LRAPP exercises.

(U) Task 2 - Conduct the necessary analysis and liaison through PMS-399 in order to recommend suitable tests, and test conditions and other parameters in order to insure that the performance of the AN/SQS-56 surface duct sonar system complies with Navy requirements.

(U) Task 3 - Conduct an area assessment of the performance capabilities of near bottom acoustic sensor systems in the northeast Pacific Ocean reflecting all high quality data available for that area.

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1.4 Attachment Number IV, 10 August 1976 (U)

(U) Task 1 - Participate in the planning, organizing and scheduling of an Ambient Noise Workshop to be held in August 1976; provide a moderator for the omnidirectional ambient noise session; prepare a summary report of results and recommendations.

(U) Task 2 - Analyze the oceanographic and acoustic characteristics of the Alboran Basin and prepare a detailed study on the subject.

(U) Task 3 - Assist in planning, organizing and conducting a CW source level and processing workshop to be held in September 1976, and prepare a summary report of the results and recommendations.

(U) Task 4 - Provide the chairman of the SUS Source Level Experiment Planning Committee and schedule necessary meetings to develop the experiment plan by 29 October 1976.

1.5 Attachment Number V, 1 November 1976 (U)

(U) Task 1 - Provide the necessary technical direction and analysis to make a detailed determination of the overall measurement accuracy of a new mid-water measurement system presently being developed by NORDA-600, including tape duplication and data reduction as carried out by NORDA-600 contractors. Based on the analysis, the Contractor shall develop a specification governing recording conditions, input information accuracy, and pass/fail criteria for both the recording and duplicating systems.

(U) Task 2 - Continue to conduct the necessary analyses and liaison through PMS-399, in order to recommend suitable tests, test conditions and other parameters in order to insure that the performance of the AN/SQS-56 Surface Duct Sonar (SUDS) System complies with Navy requirements.

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1.6 Attachment Number VI, 1 January 1977 (U)

(U) Task 1 - Provide the chairman of the SUS Source Level Experiment Planning Team and complete the presentation of the plan.

(U) Task 2 - Identify future requirements for acoustic measurements and data reduction techniques, and, in conjunction with other contractors, determine the feasibility of meeting these requirements within reasonable cost and time constraints.

(U) Task 3 - Provide the necessary technical direction to coordinate the efforts of several contractors in the analysis and tabulation of existing ambient noise data, both omnidirectional and directional, in order to insure that the results are properly integrated and interpreted in terms of the specific noise sources in support of noise model evaluation.

(U) Task 4 - Complete the analysis of ACODAC measurements for the CHURCH OPAL Exercise and assist in the completion of the environmental acoustic summary report for the Exercise.

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2.0 (C) WORK PERFORMED UNDER CONTRACT N00014-76-C-0066 (U)

(U) During the contract period July 1, 1975 to September 30, 1977 the following work was accomplished in accordance with the tasks of the contract:

2.1 Attachment Number I, 1 July 1975 (U)

(U) Task 1 - Under this task Tracor completed analysis of data collected during conduct of tasks I, II and IV of the Mediterranean ASW Augmentation Program. This effort resulted in the publication of the following reports:

"Interim Mediterranean ASW Sensor Systems Performance Summary (U)" Secret, "Mediterranean Sea Bibliography (U)" Secret, "Mediterranean Environmental Acoustic Summary (U)" Confidential, "Mediterranean Environmental Acoustic Data Catalog (U)" Confidential.

(U) Task 2 - As a result of work under task 1 of this contract, the TASSRAP O/B system was diagnosed as being unable to accurately predict TASS performance at frequencies above 200 Hz. Tracor worked with both the LRAPP staff and the NUC staff to develop modifications to TASSRAP in order to make it effective at frequencies up to 1500 Hz.

(U) Task 3 - Tracor participated in the initial planning stages for a set of SUDS II tests. Due to a budget squeeze, these tests were never conducted.

(U) Task 4 - Under this task, Tracor assisted in the preparation of the LRAPP data questionnaires in support of the 1976 Woods Hole Oceanographic Institution meeting. In addition, Tracor provided the chairman for the Data Bank Panel for the meeting and prepared and presented the results of the panel's deliberations to the meeting. As a separate effort under this task, Tracor

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investigated data banking security requirements and presented the results of the investigations to the LRAPP staff.

(U) Task 5 - Tracor provided two participants to the LRAPP Measurement Systems Advisory Group (MSAG). The conclusions that resulted from the deliberations of this group were reported in a number of letters and the MSAG-2 Recommendations for Near-Term Action, dated 30 May 1975 and the MSAG-2 Short-Term Report submitted to LRAPP, ONR Code 102-OSC.

(U) Task 6 - The area assessment of the CHURCH ANCHOR Region for MSS (March 17, 1975) was completely reformatted and rewritten during this contract period. The assessment was broadened to consider a generic class of a field of distributed near-bottom sensors. New data that resulted from the CHURCH OPAL Exercise were also included. The report that was written consists of one chapter in each of two volumes of the "Northeast Pacific Ocean Regional Assessment". The report is currently being reviewed by NORDA Code 600.

(U) Task 7 - A pre-assessment of distributed near-bottom sensors in the Indian Ocean was conducted. Extant environmental and acoustic data were reviewed and reported, along with recommendations for the collection of additional data to support near-bottom sensor development. The results of this task were reported in Tracor document "Indian Ocean Pre-Assessment" dated December 19, 1975.

(U) Task 8 - Tracor provided Mr. G. F. O'Sullivan to assist LRAPP in the conduct and analysis of exercise KENT BEACON. The results of the analyses were incorporated into the COMTHIRDFLT Final Report on the exercise.

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2.2 Attachment Number II, 25 January 1976 (U)

(U) Task 1 - This task was a follow-on to task 2 of Attachment Number I. The results of the TASSRAP effort conducted during exercise KENT BEACON were incorporated into the overall TASSRAP program plan. At the conclusion of this effort the TASSRAP program was zero funded due to budgetary problems.

(U) Task 2 - Mr. G. F. O'Sullivan assisted COMTHIRDFLT Staff in the completion of the analysis of the results of exercise KENT BEACON.

2.3 Attachment Number III, 15 May 1976 (U)

(U) Task 1 - Past LRAPP exercises were reviewed. This review led to a meeting at Woods Hole Oceanographic Institution (25-26 May 1976). Tracor provided the chairman of the ambient noise sub-panel at the meeting and a report of that sub-panel findings. The sub-panel chairman reports were compiled by Underwater Systems, Inc. (USI) and published as "LRAPP Exercise Review Report" dated 18 June 1976.

(U) Task 2 - Under the coordination of PMS-399, Tracor provided test recommendations and performance predictions to Raytheon in the development of the AN/SQS-56 for the Navy. The content of the recommendations and performance predictions was included in a number of progress reports submitted to the Navy by Raytheon.

(U) Task 3 - This task was a continuation of task 6 of Attachment Number I. As stated before, the Northeast Pacific Regional Assessment is currently being reviewed by NORDA Code 600.

2.4 Attachment Number IV, 10 August 1976 (U)

(U) Task 1 - Tracor participated in the planning, organization and scheduling of the ambient noise workshop held at ARL University of Texas on 12-13 August 1976. Tracor provided the moderator

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for the meeting and co-authored the "Report of Ambient Noise Workshop", published by USI and dated October 13, 1976.

(U) Task 2 - Tracor worked with Texas Instruments, Inc. (TI) in analyzing the oceanographic and acoustic characteristics of the Alboran Basin. The results of the analyses have been published by TI as "An Environmental Acoustic Description of the Alboran Basin", dated May 1977. The document has been submitted for review.

(U) Task 3 - Tracor assisted in the planning and organization of a CW source level workshop. Tracor provided a committee chairman and co-authored the final report, "Report of CW Workshop", dated January 24, 1977 and published by USI.

(U) Task 4 - Tracor provided the chairman of SUS source level experiment planning committee. After a number of meetings had been conducted it became apparent to the committee that the experiment could not be conducted in FY 77. Attention was then directed to the question of what data or information should be acquired. It was concluded that an experiment to establish the repeatability of SUS source levels would be most useful. This experiment was planned into the PAR/ACODAC west coast deployment of 1977. The data from this deployment have not yet been reduced.

2.5 Attachment Number V, 1 November 1976 (U)

(U) Task 1 - Tracor provided technical direction and analysis during the development of the PAR systems at TI. A number of specifications was issued in the form of LRAPP memoranda. These specifications resulted from extensive testing at TI under the direction provided by Tracor.

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(U) Task 2 - This task was undertaken to examine the integration requirements for the Surface Duct Sonar (AN/SQS-56) and TACTAS (AN/SQR-19) in FFG-7 class ships. TACTAS and LAMPS III are to be added to FFG-7 class ships, currently planned to begin with FY 79 appropriated ships. Integration of the AN/SQS-56, TACTAS, LAMPS III and ASW Command and Control elements of the Combat Direction System will occur at the same time, after first being proven at the Oliver Hazard Perry Class Combat System Land Based Test Center in FY 82 and 83.

(C) FFG-7 class ships equipped with AN/SQS-56, TACTAS and LAMPS III are intended to fulfill the following mission requirement:

"To provide self defense and effectively supplement planned and existing escorts in the protection of Underway Replenishment Groups, Amphibious Forces, and Military and Merchantile shipping against sub-surface, air and surface threats; and to conduct ASW operations in conjunction with other sea control forces tasked to ensure our use of essential sea lines of communication."

In performance of its deep water escort mission, FFG-7 class ships are expected to rely primarily on TACTAS (AN/SQR-19) for detection and classification of conventional submarines operating on diesels, and first and second generation threats at the second convergence zone. Contacts on these targets will be prosecuted by the LAMPS III system with its helicopter configured for the ASW mode. LAMPS III will re-detect the contact, reclassify, and engage the contact with air-launched MK 46 torpedoes.

(C) The AN/SQR-19 is subject to certain inherent limitations in its use as a sonar system; such as: inability to detect conventional submarines when operating on batteries; bearing ambiguity; inability to determine the range to the contact;

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limitations on bearing resolution. Of these, the inability to detect conventional submarines operating on batteries is the most serious. However, the conceptional scheme of FFG-7 operations in escort of a convoy is to simultaneously operate the AN/SQR-19 and the AN/SQS-56 in active mode. The source level of the AN/SQS-56 at 6.5 kHz is such that it seems reasonable to expect that threat submarine counter-detection of active transmissions are likely to occur only after detection of convoy radiated noise. This expectation should be verified by the results of AN/SQS-56 TECH/OPEVAL, now in progress. The AN/SQS-56 thus provides a capability to detect a conventional submarine, operating on batteries, while it is attempting to obtain a torpedo fire control solution.

(C) Although there is the capability of simultaneously operating the AN/SQS-56 and AN/SQR-19, there appears to be no compelling operational reason to integrate the two systems. The AN/SQS-56 acts as a sensor for delivery of over-the-side torpedo attacks in conjunction with the Torpedo Control Panel MK 309, whereas the AN/SQR-19 acts as a sensor for airborne torpedo attacks by the LAMPS III helicopter. A contact detected by AN/SQR-19 should never be allowed too close to AN/SQS-56 detection range since the contact may be a cruise missile carrier which can open fire well beyond the detection range of the AN/SQS-56.

(C) There do appear to be reasons to integrate the AN/SQS-56 with the AN/SQR-19 and with the ship's Combat Direction System, which are more functionally desirable rather than being operationally oriented. The following are possible integration approaches:

(C) a. Provide a digital interface for the AN/SQS-56 with the Combat Direction System. This interface would allow the possibility of deleting the MK 309 Torpedo Control Panel and performing the computation of recommended course to steer and

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firing ranges within the Combat Direction System. By performing this function in the Combat Direction System it would also be possible to track more than the single target now possible (with the MK 309), and to provide a generated target track back to the AN/SQS-56 if a target is lost.

(C)

b. Display Storing of the AN/SQS-56 with TACTAS and LAMPS III. The AN/SQS-56 display console could be replaced with a standard AN/UYQ-21 Acoustic Display Console if space could be found for the Acoustic Display Converter. If the Acoustic Display Converter for the AN/SQS-56 were slaved to the Master Acoustic Display Converter of the TACTAS/LAMPS III systems, the possibility would exist to share the consoles between the three systems (investigations of sharing of the six displays are now underway in NAVSEA 06H2). The benefits of this approach would seem to be: logistic support of a single type of sonar console rather than two different types. Capability for casualty mode operation of the AN/SQS-56 in the event of a failure of its console; increase in the number of operators able to perform TACTAS classifications, thus deferring the onset of classification saturation.

(C) Should display sharing (not to be confused with console sharing) become feasible it should be possible to interface the Sonar Control Room Displays with the ASW Officer's displays in CIC. The benefit of this (over and above console sharing) is that special purpose displays, such as acoustic performance

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predictions, and tactical PPI displays could be available to both locations resulting in improved tactical coordination of the ASW portion of the Combat Direction System.

(U) For FFG-7 class ships with AN/SQS-56 and AN/SQR-19, the two systems are independent, although they do perform complementary operational roles. No interference to the AN/SQR-19 is expected from the AN/SQS-56 active operation; however, this could be an item of concern during the AN/SQR-19 TECH/OPEVAL. There is no compelling operational reason to integrate the two sonar systems so that a target "hand-off" can be executed. However, integration of the AN/SQS-56 with the ship Combat Direction System could provide improved target handling capability.

(C) The use of an AN/UYQ-21 Acoustic Display Console for the AN/SQS-56 in conjunction with similar consoles for TACTAS and LAMPS III appears to offer operational, functional and logistic benefits for the FFG-7 class ASW system. Substitution of the AN/SQS-56 console with the AN/UYQ-21 should be studied as a part of the Surface Ship Sonar Modernization Program.

2.6 Attachment Number VI, 1 January 1977 (U)

(U) Task 1 - This task was an extension of task 4 of Attachment Number IV. The results to date are discussed on page 2-4.

(U) Task 2 - The identification of future requirements for acoustic measurements and data reduction techniques was a continuation of the work initiated in task 1 of Attachment Number V for the mid-water (PAR) system. Tracor has provided the technical direction for extensive testing at TI and ARL. This work is presently ongoing.

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(U) Task 3 - Tracor coordinated the efforts of several contractors in the analysis and tabulation of existing ambient noise data. The results of these analyses will appear in technical publications by NUSC, ARL, TI, and possibly NRL.

(U) Task 4 - The analysis of the ACODAC measurements for the CHURCH OPAL Exercise were completed and are reported in the final report "CHURCH OPAL Environmental Acoustic Summary", April 1977, LRAPP Report S77-002.

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31 Jan 06

MEMORANDUM FOR DISTRIBUTION LIST

Subj: DECLASSIFICATION OF LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP) DOCUMENTS

Ref: (a) SECNAVINST 5510.36

Encl: (1) List of DECLASSIFIED LRAPP Documents

1. In accordance with reference (a), a declassification review has been conducted on a number of classified LRAPP documents.
2. The LRAPP documents listed in enclosure (1) have been downgraded to UNCLASSIFIED and have been approved for public release. These documents should be remarked as follows:

Classification changed to UNCLASSIFIED by authority of the Chief of Naval Operations (N772) letter N772A/6U875630, 20 January 2006.

DISTRIBUTION STATEMENT A: Approved for Public Release; Distribution is unlimited.

3. Questions may be directed to the undersigned on (703) 696-4619, DSN 426-4619.

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By direction

Subj: DECLASSIFICATION OF LONG RANGE ACOUSTIC PROPAGATION PROJECT
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Declassified LRAPP Documents

Report Number	Personal Author	Title	Publication Source (Originator)	Pub. Date	Current Availability	Class.
DASC 012-C-77	Unavailable	LRAPP PACIFIC DYNAMIC ARCHIVE (U) SEPTEMBER 1976	Daniel Analytical Services Corporation	770201	NS; ND	U
SAI-78-527-WA	Spofford, C. W.	NELANT DATA ASSESSMENT APPENDIX III-MODELING REPORT	Science Applications, Inc.	770225	ND	U
PSI TR 036049	Barnes, A. E., et al.	OCEAN ROUTE ENVELOPES TAP II BEAMFORMING SYSTEM SOFTWARE FINAL REPORT	Planning Systems Inc.	770419	ND	U
Unavailable	Unavailable	TAP 2 PROCESSING SYSTEM FINAL REPORT HARDWARE DOCUMENTATION (U)	Bunker-Ramo Corp. Electronic Systems Division	770501	ADC011789	U
S01037C8	Unavailable	GENERIC FACT	Bunker-Ramo Corp. Electronic Systems Division	770501	ADC011790; NS; ND	U
Unavailable	Weinberg, H.	TASSRAP II OB SYSTEM TEST	Naval Underwater Systems Center	770601	ADB019907	U
Unavailable	Unavailable	LRAPP TECHNICAL SUPPORT	Analysis and Technology, Inc.	770614	ADA955352	U
Unavailable	Bessette, R. J., et al.	TASSRAP INPUT MODULE	Texas Instruments, Inc.	770624	ND	U
Unavailable	Unavailable	TAP-II PHASE II FINAL REPORT	Analysis and Technology, Inc.	770729	ADA955340	U
Unavailable	Unavailable	LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP)	Bunker-Ramo Corp. Electronic Systems Division	770901	ADC011791	U
SAI78696WA	Unavailable	REVIEW OF MODELS OF BEAM-NOISE STATISTICS (U)	Xonics, Inc.	770930	ADA076269	U
TRACORT77RV109C	Unavailable	FINAL REPORT FOR CONTRACT N00014-76-C-0066 (U)	Science Applications Inc.	771101	NS; ND	U
Unavailable	Unavailable	LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP)	Tractor Sciences and Systems	771130	ADC012607; NS; ND	U
Unavailable	Homer, C. I.	SUS SOURCE LEVEL ERROR ANALYSIS	Xonics, Inc.	771231	ADB041703	U
Unavailable	Fitzgerald, R. M.	LOW-FREQUENCY LIMITATION OF FACT	Underwater Systems, Inc.	780120	ND	U
Unavailable	Unavailable	MIDWATER ACOUSTIC MEASUREMENT SYSTEM - PAR AND ACODAC	Naval Research Laboratory	780131	ADA054371	U
ORI TR 1245	Moses, E. J.	OPTIONS, REQUIREMENTS, AND RECOMMENDATIONS FOR AN LRAPP ACOUSTIC ARRAY PERFORMANCE MODEL	Texas Instruments, Inc.	780228	ADB039924	U
Unavailable	Hosmer, R. F., et al.	COMBINED ACOUSTIC PROPAGATION IN EASTPAC REGION (EXERCISE CAPER): INITIAL ACOUSTIC ANALYSIS	ORI, Inc.	780331	ND	U
LRAPPRC78023	Watrous, B. A.	LRAPP EXERCISE ENVIRONMENTAL DATA INVENTORY, JUNE 1978 (U)	Naval Ocean Systems Center	780601	ADB032496	U
TR052085	Solomon, L. P., et al.	HISTORICAL TEMPORAL SHIPPING (U)	Planning Systems Inc.	780628	NS; ND	U